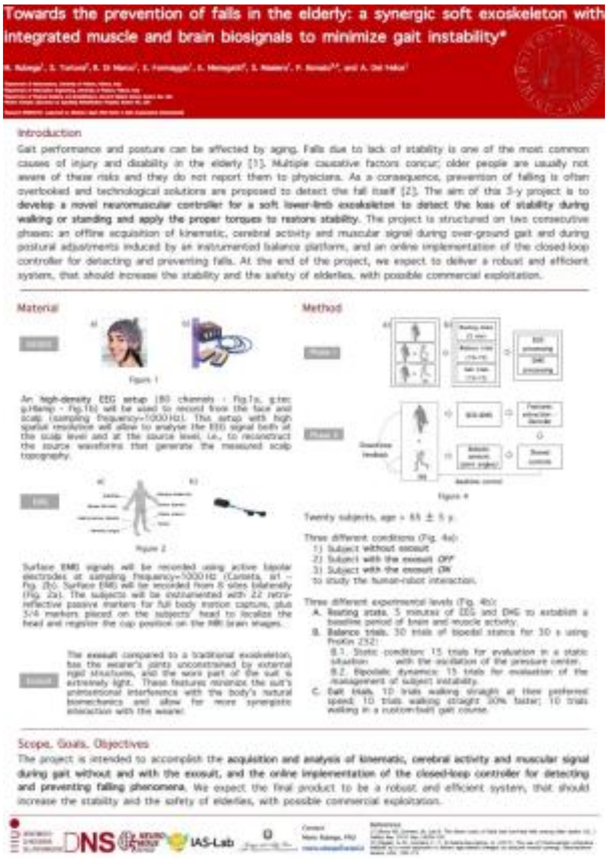
EEG, EMG & robotics in neuro-rehabilitation

Gait performance and posture can be affected by aging. Falls due to lack of stability is one of the most common causes of injury and disability in the elderly. Multiple causative factors concur; older people are usually not aware of these risks and they do not report them to physicians. As a consequence, prevention of falling is often overlooked and technological solutions are proposed to detect the fall itself. The aim of this 3-y project is to develop a novel neuromuscular controller for a soft lower-limb exoskeleton to detect the loss of stability during walking or standing and apply the proper torques to restore stability. The project is structured on two consecutive phases: an offline

acquisition of kinematic, cerebral activity and muscular signal during over-ground gait and during postural adjustments induced by an instrumented balance platform, and an online implementation of the closed-loop controller for detecting and preventing falls. At the end of the project, we expect to deliver a robust and efficient system, that should increase the stability and the safety of elderlies, with possible commercial exploitation.

The idea behind the Project

Poster presented at The Hamlyn Symposium on Medical Robotics 2019 (London, UK).



Webinar "Robotics in Rehabilitation" - 2nd December 2021

SoftAct and PRO-GAIT projects

Introduction Remarks by Alessandra Del Felice, MD, PhD - University of Padova, Dept of Neuroscience

Introduction Remarks by Olive Lennon, PT, PhD - University College Dublin

Rehabilitative and assistive robots are a rapidly emerging field. However, their efficacy is still hampered by the lack of adaptive interaction with the end user, disregarding ongoing changes in brain and muscle reactivity.

The collaborative, international research projects SOFTAct and PRO-GAIT are setting the foundation to revolutionize wearable robots: artificial intelligence techniques will provide the framework to use cerebro-muscular biosignals to control robots. This will allow wearable robots to become a natural extension of the human body in the near future.

Robotics in Neuro-Rehabilitation

Alessandra Del Felice, MD, PhD - University of Padova, Dept of Neuroscience

[Innovation in Rehabilitation Robotics]

Paolo Bonato, PhD - Harvard Medical School, Phys Med and Rehab Dept

[Walking Features before and after Exoskeleton Training]

Roberto Di Marco, PhD - University of Padova, Dept of Neuroscience

[Brain Oscillations Changes after Exoskeleton Training]

Maria Rubega, PhD - University of Padova, Dept of Neuroscience

[Intelligent Systems for Neurorobotics]

Emanuele Menegatti, PhD - University of Padova, Dept of Information Eng

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[Decoding Limb Movements/Imagined Movements from EEG fro Stroke Rehabilitation]

Damien Coyle, PhD - Ulster University

[Neural Correlates of Learning in Brain-Machine Interface]

Luca Tonin, PhD - University of Padova, Dept of Information Eng

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[Concluding Remarks]

Marco Gilli, PhD - Italian Scientific Attacahé USA

Alessandra Del Felice, Paolo Bonato, Olive Lennon

Webinar "EEG, EMG & robotics for enhancing mobility" - 3rd December 2020

Fostering Collaborative Work by Italian and American Researchers

Introduction Remarks by Ugo Della Croce, PhD - Science Attaché, Embassy of Italy in Washington DC

Clinical Applications of Rehabilitation Robotics: Are Patients Learning from Robots?

Catherine Adans-Dester, PT, PhD – Harvard Medical School

Could We Gain Clinically-Relevant Information from EEG and EMG Data Collection during Patient-Robot Interactions?

Alessandra Del Felice, MD, PhD – University of Padova

Brain Oscillations Changes in Active, Passive and Imaginary Movements

Emanuela Formaggio, PhD – University of Padova

Can Muscle Synergies Shed Light on the Mechanisms Underlying Motor Adaptations during Robot-Assisted Gait Training?

Paolo Bonato, PhD – Harvard Medical School

Human and Robot Learning in EEG-driven Intelligent Wheelchairs

Luca Tonin, PhD – University of Padova

Combining EEG and EMG Data to Control Assistive Technologies Aimed to Enhance Mobility

Stefano Tortora – University of Padova

Preliminary Results on the Investigation of EEG and EMG Patterns during the Performance of Balance Tasks

Maria Rubega, PhD and Roberto Di Marco, PhD – University of Padova

Concluding Remarks

Alessandra Del Felice, MD PhD, Stefano Masiero, MD, Emanuele Menegatti, PhD – University of Padova and Paolo Bonato, PhD - Harvard Medical School